PROF. W. ESSON, F.R.S.

IN William Esson, Savilian professor of geometry since 1897, Oxford loses one who has done much for it. A Scot whose family came South in his boyhood, there was the air of a viking about him, and few who looked upon his magnificent beard during most of the sixty-one years of his university life were not conscious of a radiation of vigour as from the North. Born at Dundee in 1838, he was educated first at Inverness, and then at Cheltenham Grammar School. In 1855 he became Bible clerk of St. John's College, Oxford. Here he obtained two second classes (1856, 1858) in classics, and in mathematics carried all before him, gaining first classes in 1856 and 1859, and the junior and senior mathematical scholarships in 1857 and 1860. In 1860 he became Fellow of Merton and mathematical tutor. He was also tutor or lecturer for various periods at Magdalen, Corpus, Worcester, and Hertford. Enormous as have been his services to Merton and to the university as financier and man of business, and real as have been his achievements in geometrical and mathematico-chemical investigation, the writer and others put first his leadership in college mathematical teaching. In the 'sixties and 'seventies there were two classes of mathematical students in Oxford—those who blessed the Providence which had put them under him, and those who envied the others.

When Prof. Sylvester's health began to fail in 1894 Esson became deputy Savilian professor of geometry, and after three years he succeeded Sylvester in the chair. He lectured most on the comparison of synthetic and analytic methods in geometry. With such subjects his not very numerous publications in pure mathematics have been concerned. They are above all things incisive. Probably he was prouder of his only semi-mathematical work on chemical—or, as he was always very careful to say, *chymical*—change. This was done largely in concert with Mr. A. G. Vernon Harcourt, and expounded in the Philosophical Transactions for 1864, 1866, and 1895. The work secured him the Fellowship of the Royal Society as early as 1869. Among the little jokes in which he delighted was one that in 1897 the Savilian professorship of *geometry* passed from a poet to a *chymist*.

Though as professor he became Fellow of New College, he was bursar of Merton till he died. For very many years he served the university as a curator of the university chest; and here his loss will be keenly felt. His great administrative powers were used for the good of the university in matters directly associated with university studies, and not in finance only. For about fifteen years, ending in 1913, he was chairman of the Board of the Faculty of Natural Science. He was a visitor (and secretary) of the university observatory.

Until a few months ago his natural force seemed in no wise abated. But his last surviving son went down with H.M.S. *Russell*, and his strength then began to fail.

PROF. S. B. MCLAREN.

LIEUT. S. B. McLAREN, professor of mathematics in University College, Reading, met his death on August 14 on the Western front, where he was serving with a signalling company of the Royal Engineers.

McLaren was of Scottish parentage. A son of the late Rev. W. D. McLaren, of Melbourne, he was born in Japan, but most of his early life was spent in Australia. After a distinguished career at the University of Melbourne, he proceeded to Trinity College, Cambridge, of which he became a major scholar. He was third wrangler in 1899, gained a first class in Part II. of the Mathematical Tripos in 1900 and the Isaac Newton studentship in 1901. He continued in residence at Cambridge until 1903, when he accepted a position at Bristol University College, whence in 1906 he proceeded to Birmingham University as assistant-lecturer in mathematics. Shortly before his appointment to the professorship of mathematics in University College, Reading, he had shared with Prof. Nicholson the Adams prize at Cambridge.

The outbreak of war found McLaren in Australia with the British Association, acting as a secretary of Section A, and back with his parents and among his earlier friends. During the return voyage he was fired with an enthusiasm to offer his services to his country, and he employed his time on board in learning signalling, and on arrival joined the signalling company organised by a colleague, Major Pearson, of University College, Reading. He saw several months of active service before receiving the wound which only a few days later proved fatal. He was fearless and intrepid on the field, and carried out his duties tirelessly and with a disregard for his personal safety which was at once an inspiration to his men and the concern of his brother officers.

McLaren's published work, which was characterised by originality and a fine boldness of conception, related particularly to the mathematical treatment of the phenomena of radiation and of gravity. Shortly before he gave up his academic work he was engaged in writing upon the magneton, and he considered that he had obtained results of value. But his interest in mathematical physics is not adequately gauged by his published work. He was a diligent worker and thinker, contrary, perhaps, to the impression of the casual acquaintance, and he sought strenuously for a basis upon which to build. His interest in philosophy was part and parcel of his regard for the fundamental things. All who have been associated with him will regret the cutting short of a promising career and the loss of a simple, sincere, and genial friend.

W. G. D.

NOTES.

THE terms of reference, and the constitution, of the two committees appointed by the Prime Minister to inquire into the position of science and modern languages respectively in the system of education in Great Britain have now been announced. The membership of the committees suggests that the Government wishes each of these subjects to be considered chiefly from the point of view of education as a whole; for the particular interests of science and modern languages are represented by a few members only. The terms of reference and constitution of the Science Committee are as follows:—To inquire into the position occupied by natural science in the educational system of Great Britain, especially in secondary schools and universities; and to advise what measures are needed to promote its study, regard being had to the requirements of a liberal education, to the advancement of pure science, and to the interests of the trades, industries, and professions which particularly depend upon applied science; Sir J. J. Thomson (chairman), the Rt. Hon. F. D. Acland, Prof. H. B. Baker, Mr. Graham Balfour, Sir William Beardmore, Bart., Sir G. H. Claughton, Bart., Mr. C. W. Crook, Miss E. R. Gwatkin, Sir Henry Hibbert, M.P., Mr. William Neagle, Mr. F. G. Ogilvie, C.B., Dr. Michael Sadler, C.B., Prof. E. H. Starling, Mr. W. W. Vaughan; secretary, Mr. F. B. Stead, H.M. Inspector of Schools. Owing to unforeseen circumstances Lord Crewe finds that it will not be possible for him to act as chairman of the committee, as previously announced.

THE terms of reference and constitution of the Modern Languages Committee appointed by the Government are as follows:—To inquire into the position occupied by the study of modern languages in the educational system of Great Britain, especially in secondary schools and universities, and to advise what measures are required to promote their study, regard being had to the requirements of a liberal education, including an appreciation of the history, literature, and civilisation of other countries, and to the interests of commerce and the public service; Mr. Stanley Leathes, C.B. (chairman), Mr. C. A. Montague Barlow, M.P., Mr. E. Bullough, the Rt. Hon. Sir Maurice de Bunsen, Mr. A. G. Coffin, Dr. H. A. L. Fisher, Mr. H. C. Gooch, Mr. J. W. Headlam, Mr. L. D. Holt, Dr. Walter Leaf, Dr. G. Macdonald, Mr. A. Mansbridge, Mr. Nowell Smith, Miss M. J. Tuke, Sir James Yoxall, M.P.; secretary, Mr. A. E. Twentyman. In considering the provision of scholarships, bursaries, etc., the committees are requested to take into account the interim report of the consultative committee of the Board of Education on this subject.

LORD MONTAGU OF BEAULIEU, in a speech at Bury St. Edmunds on August 23, gave some interesting particulars of Germany's new super-Zeppelins. These are said to have a capacity of 2,000,000 cubic ft., giving a total lift of about 60 tons. Their length is 780 ft., speed 65 miles per hour, and the engines develop more than 1500 horse-power. (The original figure given was 15,000, but this was an error, and has since been corrected.) These figures are a little surprising, but there seems to be no reason why such an airship should not be satisfactorily designed, especially after the experience which Germany has had with the older types. It would appear that these super-Zeppelins are intended for offensive operations, rather than as scouts for the fleet, for which latter purpose the existing types are of sufficient capacity. If this is the case, our anti-aircraft defences will need to be as efficient as we can make them. Raids by means of rigid airships have introduced a new problem for the gunnery experts to solve, for a Zeppelin at 10,000 ft. altitude, and moving at 60 miles an hour on a dark night, presents an exceedingly difficult target, and the small number of hits scored up to the present is not surprising. However, a great deal is being done to deal with this new situation, and it is to be hoped, as Lord Montagu said, that the super-Zeppelins will not achieve the results which our enemies seemingly anticipate.

SIR ERNEST SHACKLETON is losing no opportunity of attempting to rescue his stranded comrades on Elephant Island. Last Saturday he sailed from Punta Arenas on his fourth attempt. This time his vessel is the *Yelcho*, a small Chilian steamer which towed the *Emma* 240 miles south of Cape Horn in the last unsuccessful attempt at rescue. The *Yelcho* does not appear to be well suited for the task before her, but, failing such a ship as the *Discovery*, now on her way out, one vessel is little better or worse than another, and success or failure depends entirely on the ice conditions. In this respect there is some prospect of September proving better than July or August. If Elephant Island is clear of ice, the *Yelcho* should return to civilisation early in September with the explorers on board.

WE regret to announce the death, on August 27, at sixty-three years of age, of Dr. C. T. Clough, district geologist of H.M. Geological Survey, Scotland.

THE twenty-seventh annual general meeting of the Institution of Mining Engineers will be held at Glasgow on September 14–15. The institution medal for the year 1915–16 will be presented to Dr. W. N. Atkinson, in recognition of his investigations in connection with colliery explosions and coal-dust.

SIR CHARLES H. BEDFORD has been appointed general secretary of the newly constituted Association of British Chemical Manufacturers. The business of the association is for the present being carried on at the offices of the Society of Chemical Industry, Broadway Chambers, Westminster.

THE Toronto correspondent of the *Times* states that the Naval Service Department in Ottawa has received the following message from Dr. Anderson at Nome respecting the Stefansson expedition:—"Starkerson has reported that Stefansson is safe on north-west coast, where he was reported on May 7. The *Polar Bear, Mary Sachs,* and *North Star* are safe."

CAPT. A. R. BROWN, formerly science master at Buckhaven High Grade School, and 2nd Lieut. H. Watson, mathematical master at Ormskirk Grammar School, have both been killed in action. Capt. Brown was educated at Airdrie Academy and Glasgow University, where he graduated M.A. and B.Sc., and he was a fellow of the Royal Society of Edinburgh. 2nd Lieut. Watson was educated at Burnley Grammar School and Manchester University, where he graduated with first-class honours, obtaining his degree of B.Sc. in 1907. Before going to Ormskirk he held the position of mathematical master at the Technical Institute and Secondary School, Salford.

DURING the early hours of August 16 an earthquake was felt at Ancona, Pesaro, Rimini, and other places on the north-east coast of Italy. The shock seems to have been strongest at Rimini, where several houses were wrecked, though buildings were also damaged at Pesaro, twenty miles to the south-east. All three places lie within well-defined seismic zones, but, while the earthquakes of the Pesaro and Ancona zones are usually of a local character, those of the Rimini zone (and especially the earthquakes of 1672 and 1875) are often felt over a wide area. According to the *Times* of August 17, seven earthquakes were recorded at Shide on August 16, originating in northern Italy or in Austria.

THE autumn meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers on September 21 and 22. The following papers are expected:—"Some Properties of Ingots," H. Brearley; "Influence of Heat-Treatment on the Thermoelectric Properties and Specific Resistance of Carbon Steels," Prof. E. D. Campbell; "Heat Treatment of Eutectoid Carbon Steels," Dr. H. M. Howe and A. G. Levy; "Steel Ingot Defects," J. N. Kilby; "Manganese Ores of the Bukowina, Austria," H. K. Scott; "Influence of Elements on the Properties of Steel," Dr. J. E. Stead; "Notes on (*a*) Nickel Steel Scale, (*b*) on the Reduction of Solid Nickel and Copper Oxides by Solid Iron, (*c*) on Effect of Blast-furnace Gases on Wrought Iron," Dr. J. E. Stead; "Use of Meteoric Iron by Primitive Man," G. F. Zimmer.

WE regret to notice that Sir Richard Biddulph Martin, the chairman of Martin's Bank, died on August 23, in his seventy-eighth year. Sir Richard Martin was not only an eminent banker and one of the founders of the Institute of Bankers, but also gave much time during his long and active life to the work of charitable and social undertakings, and of more than one scientific society. Of the Fishmongers' Company he was twice Prime Warden, and represented the company on the Executive Committee of the City and Guilds of London Institute. He had held the office of treasurer of the Royal Statistical Society of London since 1875, the longest period of office of any treasurer since the foundation of the society, and was elected to the presidency in 1906. He always exhibited the warmest interest in the welfare of the society, and was a regular attendant at council and ordinary meetings until increasing lameness in recent years rendered attendance almost a physical impossibility. Sir Richard was also keenly interested in the work of the Royal Anthropological Institute, of which he was a vice-president, and in that of the Royal Geographical Society.

A RECENT article by Dr. Saleeby on "Armoured Men," published in the *Daily Chronicle* of August 7, gives some particulars as to the construction of the "soup-plate" helmet with which British troops are now provided. It is really a double structure. It is first a soft cap, bounded all round its edge with thick rubber studs—now made hollow for greater resilience. This cap has a double lining of felt and wadding, so that even if the helmet be pierced at point-blank range the scalp is guarded from the steel. Upon this padded cap is poised the casque of steel. The interval between the two serves for ventilation. The steel used is that discovered some twenty years ago by Sir Robert Hadfield, and known as manganese steel. The helmet weighs 2 lb., and is said to be bullet-proof to a Webley automatic pistol at five yards' range. Every helmet now supplied to the troops is proof against a shrapnel bullet, forty-one to the pound, with a striking velocity of 750 ft. per second. To prevent the surface from acting as a mirror it is sanded and roughened. The helmet is fixed with an adjustable strap under the chin, and its rim is blunted so as to avert injury to the temples of the next men's heads in the close company of the trenches. The pitch of the helmet is made as low as possible. Dr. Saleeby finally urges that the protection of similar steel should be now applied to other vital parts of the body. It is estimated that this would cause an addition of not more than 4 lb. to the weight carried by the soldier, and that this addition could be compensated by the temporary reduction of other equipment, at least when the soldier is storming positions held by the enemy.

THOSE who are interested in iconography will welcome the paper by Prof. Flinders Petrie on "Early Forms of the Cross from Egyptian Tombs," published in part iii. of *Ancient Egypt* for 1916. The numerous examples illustrated are taken from tombs of the fourth and fifth centuries B.C. As persecution increased in Egypt there arose a tendency to disguise the forms of the symbol, so that it should be recognisable only by the initiated. Prof. Petrie disregards the so-called Tau cross, represented in some dictionaries as having come from Egypt. He says that he has never seen it represented or described there, and he does not understand why Egypt has been regarded as its source. On the other hand, he has no doubt of the Egyptian origin of early crosses found in Great Britain and Ireland, though most of these have the long form which, probably with the object of disguise, was at an early period abandoned in Egypt and replaced by that of the square shape.

PROF. M. CAULLERY'S introductory "exchange" lecture at Harvard on "The Present State of the Problem of Evolution" is published in *Science* of April 21 last. He surveys broadly, in this discourse, the progress of biological speculation from the beginning of the nineteenth century, pointing out that some recent interpretations of heredity tend to bring the concept of evolution into line with the "evolutio" of pre-Lamarckian philosophers. With these interpretations Prof. Caullery admits imperfect sympathy, and promises his hearers "support of a transformism more or less Lamarckian." From this introductory lecture they may look forward to a stimulating course, and Prof. Caullery's graceful tribute to American workers in biology—from Louis and Alexander Agassiz to E. B. Wilson, Loeb, and Castle—must have been welcome to his hearers at Harvard.

ON the other hand, Dr. Chas. B. Davenport, writing in the *American Naturalist* (l., No. 596, August, 1916) on "The Form of Evolutionary Theory that Modern Genetical Research seems to Favour," expresses belief in "internal changes chiefly independent of external conditions" as furnishing the effective agency in development. He adopts Bateson's suggestion of a primitive germ-plasm with highly complex constitution, from which factors ("genes") have become split off and lost in the course of ages, thus giving rise to new forms of life. Yet Dr. Davenport does not absolutely exclude environmental influence. "There is some evidence," he admits, "although not as critical as might be wished, that the germ-plasm is not beyond the reach of modifying agents."

THE last meeting of the session of the Zoological Society of London was held on August 16, Dr. Henry Woodward being in the chair. The report laid before the meeting was most gratifying, since it showed that the number of visitors to the Gardens from January 1 to July 31 showed an increase of 14,619, as compared with the corresponding period of 1915, while the receipts during the same period showed an increase of 733*l*., as compared with the corresponding period of last year. The number of new fellows admitted also showed an increase. Among the most noteworthy additions to the society's collection during the month of July were a pair of Fennec foxes, *Vulpes zerda*. This species is the smallest existing member of the Canidæ, and is found not only all over the Sahara, but extends also into south-western Asia.

A REPORT of considerable value and interest appears in the *Meddelelser fra Kommissionen for Havundersøgelser* on "Marking Experiments with Turtles in the Danish West Indies," by Dr. Jos. Schmidt. Four species are found in this area—the leathery, loggerhead, hawksbill, and green turtles—and the author gives a brief but extremely useful summary of their breeding habits, supplemented by some excellent figures of newly hatched specimens of each species. The leathery turtle and the loggerhead have no great commercial value, but their eggs are taken in large numbers. The green turtle, however, for its meat, and the hawksbill for the sake of its horny shields, which form the "tortoiseshell" of commerce, are subjected to a heavy toll, young and adults alike being taken. The green turtle is happily enabled to lessen the strain of this persecution in that it lays its eggs so near the margin of the sea that all traces of their whereabouts are obliterated by the wash of the tide. Since the Danish West Indies have recently been purchased by the United States it is to be hoped that stringent protective measures will speedily be devised and enforced, for it is evident that otherwise the extermination of these colonies is within measurable distance.

IN a "Note on the Economic Uses of Rosha Grass, *Cymbopogon martini*, Stapf," published in the "Indian Forest Records," Mr. R. S. Pearson points out that this grass exists in two forms, known to the natives as "Motia" and "Sofia." The two forms appear to differ morphologically only in the fact that in the Motia grass the leaf blade makes a wider angle with the culm than is the case in the Sofia grass. The distribution of the two forms also differs considerably, Motia growing in isolated clumps on bare hot slopes, whilst Sofia occurs on low ridges and in shady nullahs often as a dense crop. The chief difference between the two forms lies, however, in the characters of the essential oils they contain, Motia grass yielding "palmarosa oil," containing as much as 90 per cent. of free and combined geraniol, whilst the Sofia form yields the so-called "ginger grass oil," containing only about half as much geraniol. The note states that experimental cultivation of the two forms has now been undertaken at Dehra Dun by Mr. R. S. Hole with the view of determining their botanical relationship.

THE Journal of the Society of Siberian Engineers (Tomsk, March, 1916) directs attention to the backward state of Russian agriculture in the matter of the employment of artificial fertilisers, and emphasises the vital necessity of reform in this direction. In contrast with other countries it is pointed out, among other things, that Russia does not yet possess a single factory for utilising atmospheric nitrogen in the preparation of fertilisers, though she has ample supplies of raw material and water-power.

AN interesting instance of untutored native ability is reported from Tomsk in the Journal of the Society of Siberian Engineers (January, 1916). In the Ochansky district a self-taught farm labourer, Kazymov by name, working on the model of the American machines, made a horse reaper of a very simple type, weighing only 400 lb., and capable of being worked easily by one horse. The local council, on hearing of this, considered it sufficiently important to warrant official investigation, and appointed a special committee for that purpose. After inspecting the machine the committee came to the conclusion that although of very primitive construction it is suitable for the work and might with some trifling technical alterations be widely adopted, seeing that it is superior to the factory-made machine in lightness and in suitability for the small "one horse" farmer. The price of the Kazymov reaper may be estimated approximately at 8*l*.

THE distribution of cyclonic precipitation in Japan is the subject of a paper by Messrs. Terada, Yokota, and Otuki in the Journal of the College of Science, Tokyo, vol. xxxvii, art. 4. The paper is partly a statistical investigation of the influence of land and water in modifying the rainfall from 1905 to 1915, but contains also an attempt to analyse the factors that determine the unsymmetrical distribution of precipitation. These the authors group as (1) thermal and planetary, which depend on latitude; (2) thermal and geographical, which depend on the prevalence of sea or land; (3) hydrodynamical and topographical, caused by the ascending air current. The whole discussion is somewhat hypothetical, and would be more profitable were the data more numerous.

THE eruption of Mauno Loa which took place last May is briefly described by Mr. H. O. Wood in the Weekly Bulletin of the Hawaiian Volcano Observatory (vol. iv., No. 5, 1916). Fume-columns were first noticed at 7 a.m. (or 5.30 p.m., G.M.T.) on May 19. At 8 a.m. the crown of the cloud had reached a height of not less than 20,000 ft. above the mountain profile, but by noon the rush of fumes had almost ceased. A small amount of lava was ejected at the time of this outburst. Shortly after 11 p.m. on May 21 another and greater flow began from a source lower down the slope, at an altitude of about 7000 ft. on the south-south-west slope of the mountain. Hundreds of very slight tremors were registered during these days at the Volcano Observatory on the north-eastern slope of Kilauea, though only three or four were strong enough to be felt in the neighbourhood of the observatory.

THE August number of the Proceedings of the Physical Society of London completes vol. xxviii. The seven papers included in it cover seventy pages, and are of exceptional interest. Mr. G. D. West deals with the effects of the residual gas in measurements at low gas pressures of the pressure due to radiation. Miss Humphrey and Dr. Hatschek show that the viscosity of a liquid having small solid particles in suspension increases more rapidly than the aggregate volume of the suspended matter, and depends on the rate of shear. Capt. Phillips describes a form of mercury jet interrupter by means of which he has investigated the conditions which determine the smooth working of the interrupter. Dr. P. E. Shaw and Mr. C. Hayes describe a magnetometer of the torsion balance type a million times as sensitive as any previous instrument. Dr. S. W. J. Smith discusses the relation between the original migration experiments of Hittorf and the recent ones of Mrs. Griffiths, which have given somewhat different results. Dr. Allen shows that Ratnowsky's recent theory of the process of fusion is incorrect, and Dr. Chatley describes the present position of the attempts to explain cohesion and shows that it must be regarded as the difference between the attractive and repulsive forces between molecules.

THE sixth annual report of the Road Board has just been issued. The amount of new work sanctioned has been reduced greatly, but the Board has continued to supervise the construction and maintenance of new roads required for military purposes, and this work has extended considerably. An account of the method of testing surfaces by rotary machine is included. The machine consists of a revolving frame supported on wheels running on a circular test path at any desired speed—not exceeding seven miles an hour for steel tyres. Each of the eight wheels is independently driven by electromotors. The usual load per inch width of tyre has been about 470 lb. Since wetted surfaces can be tested to destruction sooner than dry surfaces, the wet test has become the standard of comparison. A room temperature approaching that of summer has generally been maintained, since bituminous materials soften and show the least resistance to deformation during the summer months. After the test track has been laid, the machine is started and run on the new surface with a gradually increasing load until about 4000 to 6000 tons per yard of width have rolled over it; this is called the consolidation period. The test proper is then commenced, and the machine is run at a rate of about 2200 tons per yard of width per hour. In most cases with good materials a well-laid surface remains smooth and polished until about 200,000 tons per yard of width have rolled over it. About this stage wave-like markings begin to appear; these gradually extend until at 400,000 tons the surface becomes considerably waved and the vibration is excessive. The test is then considered complete. The results of four tests with mexphalte and aztecphalte are included, and are of interest as showing that considerable difference in the durability may be caused by the method of laying and by the workmen employed.

WE have received a booklet entitled "Economical Dishes for War-time," by Miss Florence A. George (Messrs. Cornish Bros., Birmingham, price 6*d.*). It contains a number of useful recipes for the preparation of economical meat and vegetable dishes and sweets. A brief introduction deals with the food requirements of the body, and at the end some hints are given on the management of gas-stoves.

THE following books are in the press for inclusion in the "Cambridge Technical Series" of the Cambridge University Press:—"Experimental Building Science," vol. i., J. Leask Manson; "Alternating Currents," W. H. N. James; "Development of English Building Construction," C. F. Innocent; "Naval Architecture," J. E. Steele; "Chemistry and Technology of Oils and Fats," F. E. Weston and P. J. Fryer; "Physics for Engineers," J. Paley Yorke; "Chemistry of Dyeing," Dr. L. L. Lloyd and M. Fort.

OUR ASTRONOMICAL COLUMN.

BRIGHT DISPLAY OF AURORA BOREALIS ON AUGUST 27.—A fine exhibition of Aurora Borealis was observed by Mr. W. F. Denning at Bristol in the early morning of Sunday, August 27, between the hours of 2 and 4 G.M.T. Shafts of light were first observed at about 2h. 15m. ascending amongst the stars of Ursa Major and Draco, and reaching considerable altitudes. Changes affected the appearances at short intervals, the streamers would fade away and new ones form, while the invariable disposition of the whole was to move quickly from the west to the east side of the north point. Some of the more conspicuous streamers were particularly recorded as they passed over certain stars, and the mean rate of motion across Ursa Major was found to be 15° in three minutes.

The active region seemed to extend from as nearly as possible N.W. to N.E., but the N.W. and N. showed the greatest abundance of streamers; in the N.N.E. there was a succession of faint bands of light rising upwards to the left of Auriga. Many of the rays observed in the N. region could be faintly traced to altitudes of 70°. The phenomenon was watched until 3.45, when the sky had regained its normal appearance, and twilight had become strong in the north-east.

DISTRIBUTION OF THE POLES OF PLANETARY ORBITS.—Prof. H. C. Plummer recently found that the mean pole of the orbits of the minor planets was situated at a distance of 53′ from the pole of the ecliptic, in longitude 16·7°, and he was led to investigate its relation to the poles of the major planets (*Monthly Notices*, R.A.S., vol. lxxvi., p. 378). A diagram showing the relative positions of the poles revealed several features of interest, to which no special attention had previously been directed. It thus appeared: (1) that the poles lie three by three on five lines; (2) that the pole of each orbit, with the exception of Neptune, lies on two of these five lines; (3) that each line contains the orbital poles of two adjacent major planets. Prof. Plummer found it difficult to believe that this was merely a chance arrangement. Prof. J. B. Dale has since directed attention to further interesting features of the polar diagram (Roy. Ast. Soc., June). On measuring the inclinations of the five lines to the line drawn from the pole of the ecliptic in the direction 315°, he obtained the following results:—

(1) Earth—Mars—Mercury, $3^\circ = 82^\circ - 79^\circ$.
(2) Earth—Uranus—Venus, $31^\circ = 82^\circ - 51^\circ$.
(3) Uranus—Jupiter—Saturn, $82^\circ = 82^\circ$.
(4) Mars—Jupiter—Neptune, $136^\circ = 82^\circ + 54^\circ$.
(5) Mercury—Venus—Saturn, $161^\circ = 82^\circ + 79^\circ$.

The directions of the five lines can thus be expressed very closely by the formulæ, α, $\alpha \pm 2\beta$, $\alpha \pm 3\beta$, where $\alpha = 82^\circ$ and $\beta = 26\frac{1}{8}^\circ$.

The diagram also shows that there are several pairs of lines joining poles which are nearly parallel. There is apparently nothing in the theory of the secular perturbations of the nodes and inclinations of the planetary orbits which would lead to the expectation of such definite relations, or to the continuance of these relations if they did exist at a given time, but Prof. Dale considers it almost incredible that the should be purely accidental. He inclines to the view that these remarkable relations may indicate the action of other forces, such as might be due to a resisting medium, in addition to the gravitational forces.

SOLAR VARIABILITY.—For the more precise study of the distribution of radiation of different wave-lengths across the sun's disc, the observing station of the Smithsonian Institution at Mount Wilson has been provided with a tower telescope having a concave mirror of 12-in. aperture and 75-ft. focal length. A description of this instrument, together with some of the observational results for 1913 and 1914, has been given by Messrs. Abbot, Fowle, and Aldrich (Smithsonian Miscell. Collections, vol. lxvi., No. 5). Spectro-bolometric measurements were made at seven different wave-lengths, namely, 3737, 4265, 5062, 5955, 6702, 8580, and 10,080. The new results agree closely with those obtained at Washington in 1907, so far as the two series are comparable, and the curves of intensity distribution show in a very striking way the greater uniformity of the light across the disc as the wave-length increases. There were, however, slight, but significant, differences between the mean results for different years, a greater contrast of brightness between the centre and edge occurring in 1907 and 1914, as compared with 1913, taken as a standard; that is, in years when the solar constant was high the solar contrast was greater than usual. Besides the long-period change, there were small changes of contrast from day to day, correlated with short-period fluctuations of solar radiation; for this type of variation increase of solar radiation was attended by *decrease* in the contrast between the edge and centre of the disc. The authors are thus led to consider that there are two causes of change existing in the sun: (1) the increased effective solar temperature accompanying high solar activity, producing increased radiation and increased contrast; (2) the varying transparency of the outer solar envelopes from day to day, increased transparency resulting in increased radiation but decreased contrast.